



open TRV



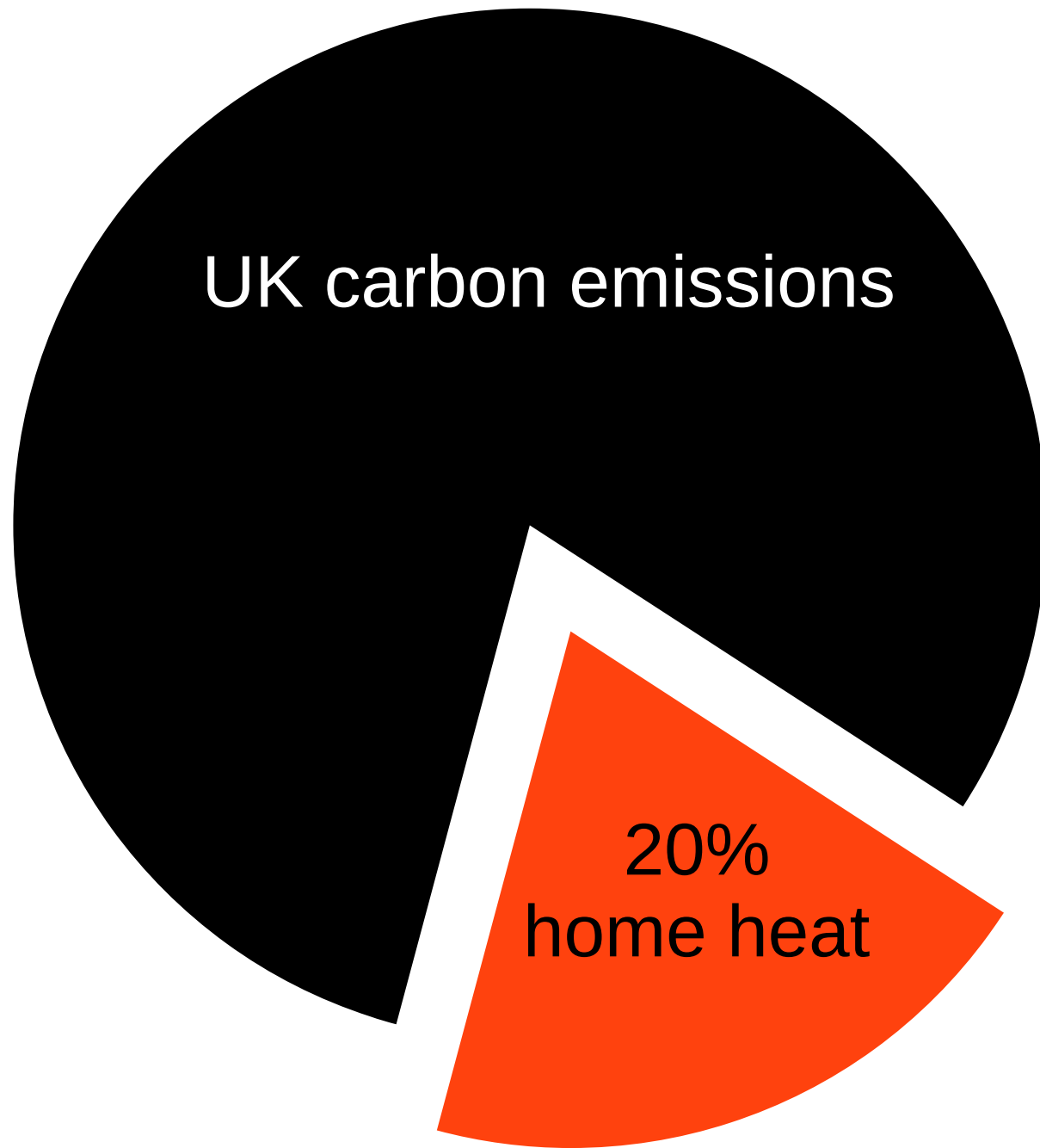
building the smart city

Damon Hart-Davis

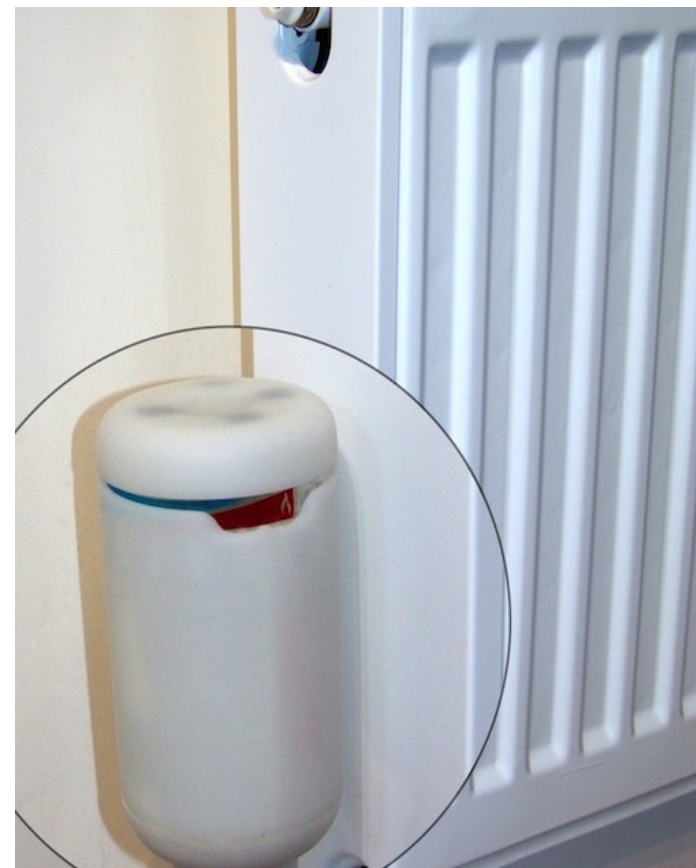
w opentrv.org.uk

t [@opentrv](https://twitter.com/opentrv)

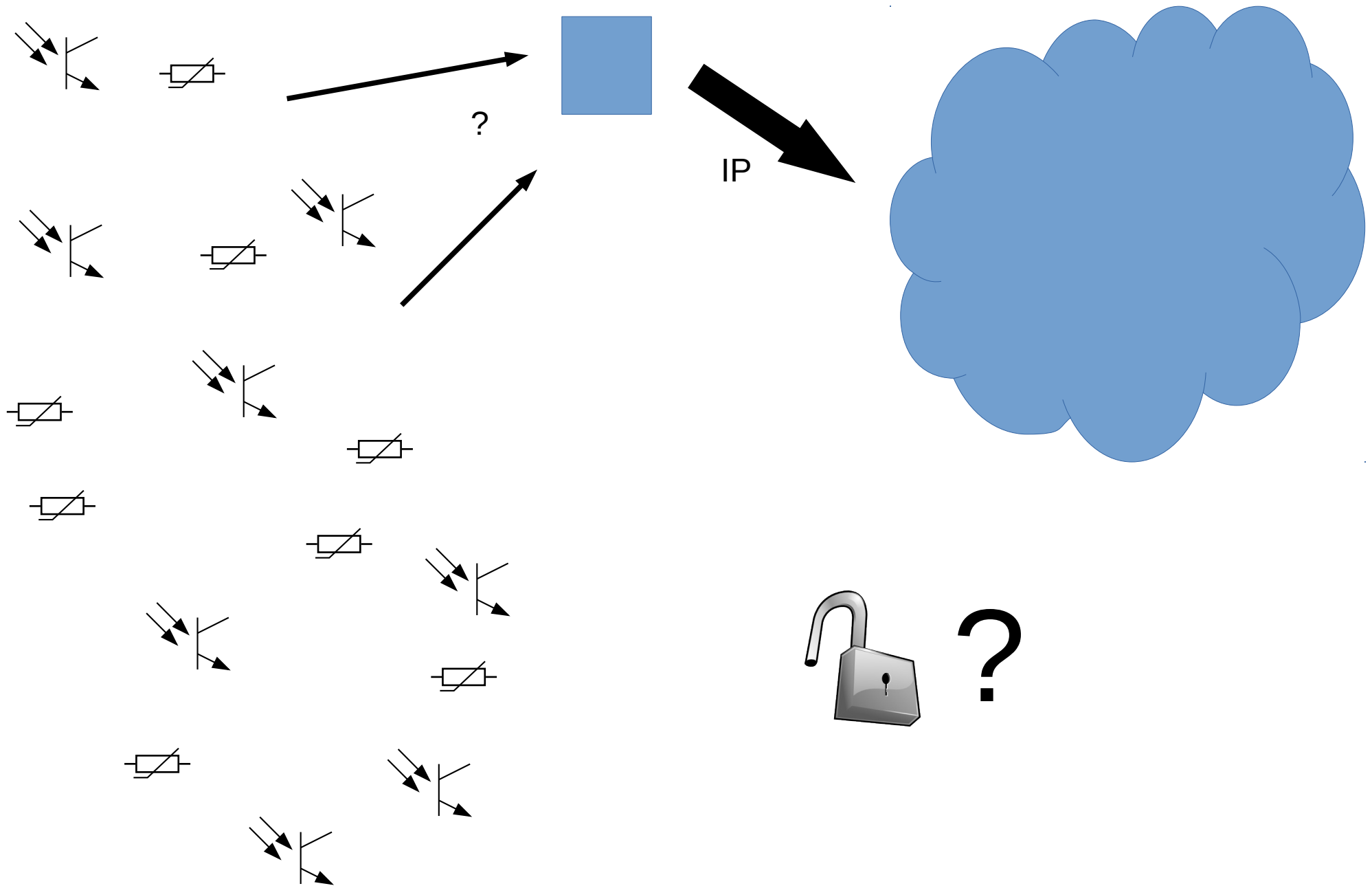
e opentrv@opentrv.org.uk



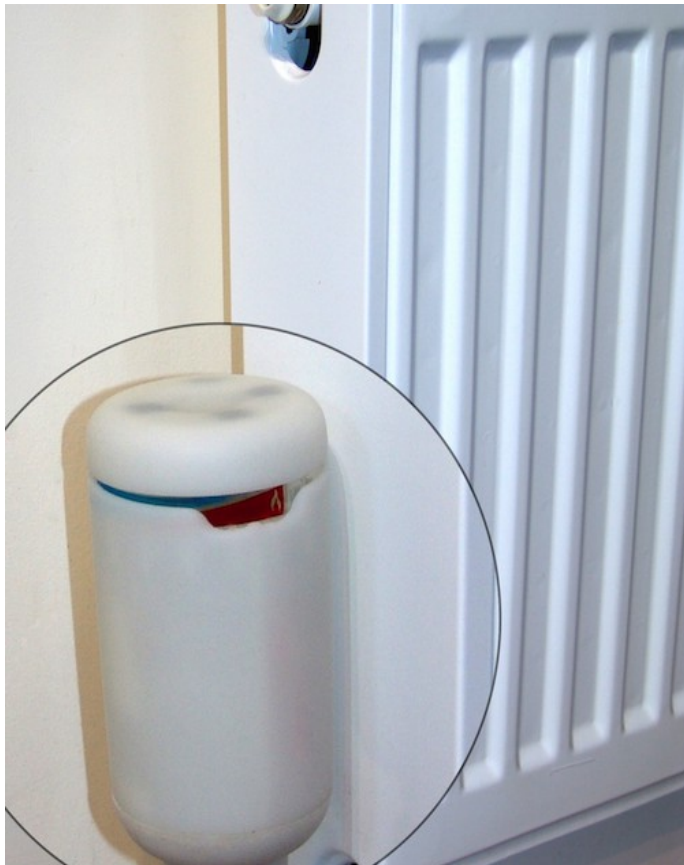
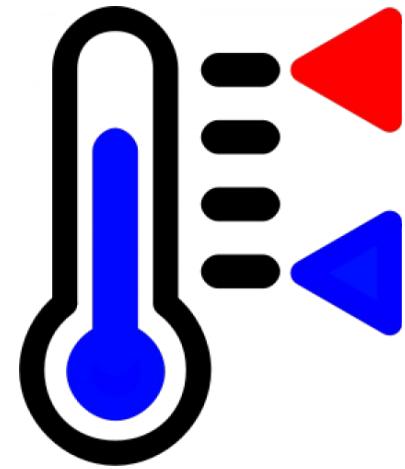
Problem: UK carbon emissions from domestic space heat 20%, gas bill £10bn/y, 50% wasted



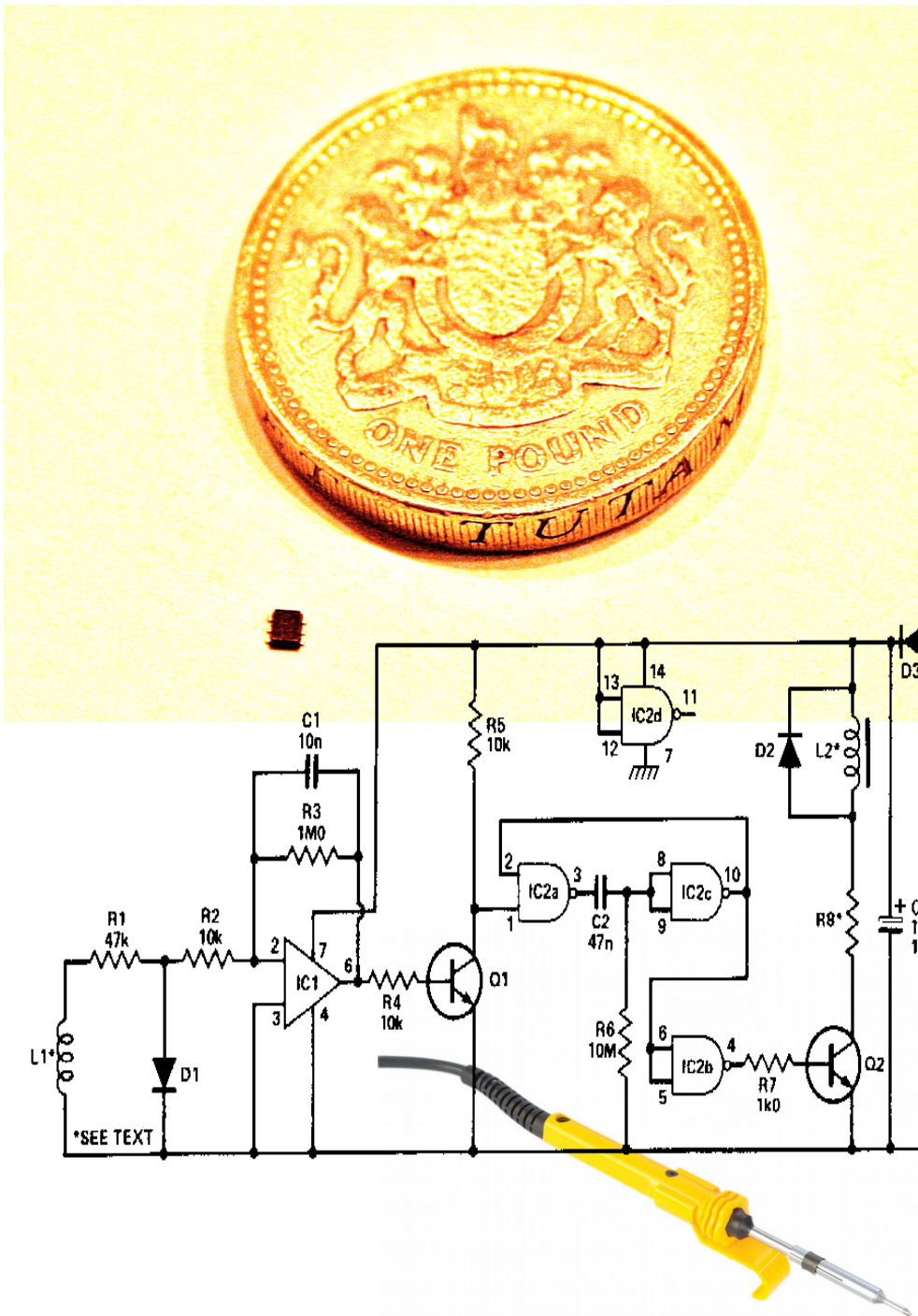
Solution: £10, user retrofit, 50% savings, occupancy + interlock, ISM, open “heating WiFi”, BoE



IoT business case: “If you can measure, you can manage”. NB “I” too big for small “T”!



Cities: buses (transport), building health, efficiency, air + other env (20k temps across London?)



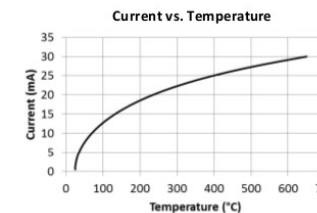
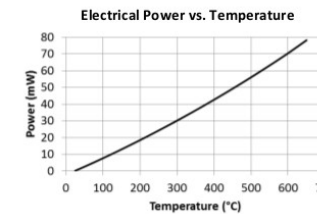
Electrical Characteristics

Parameters	Conditions	Typical Value	Units
Operating Temperature		600	°C
Thermal Rise Time (t_{R0})		15 ± 5	ms
Thermal Fall Time (t_{F0})		30 ± 5	ms
Power Consumption (P_{VI})	DC @ 600 °C	72 ± 7	mW
Heater Voltage (V_{H1})		2.4 ± 0.3	V
Heater Current (I_{H1})		30 ± 4	mA
Ambient Resistance (R_0)		40 ± 10	Ω
Heater Resistance (R_1) ¹		80 ± 20	Ω
Heated Area		0.05	mm ²
Emissivity	2 - 14 μm wavelength	0.7	
Frequency at 50% Modulation		38	Hz
Lifetime	600 °C @ 50% duty cycle	>5	years

Note:

- $R = (R_0 - RT)[1 + \alpha(T - T_0) + \beta(T - T_0)^2] + RT$; $T_0 = 25^\circ\text{C}$;
 RT (Track Resistance) = $12\Omega \pm 0.5\Omega @ 25^\circ\text{C}$; $\alpha = 2.05 \times 10^{-3} \text{ K}^{-1}$; $\beta = 0.3 \times 10^{-6} \text{ K}^{-2}$

Infrared Source Performance



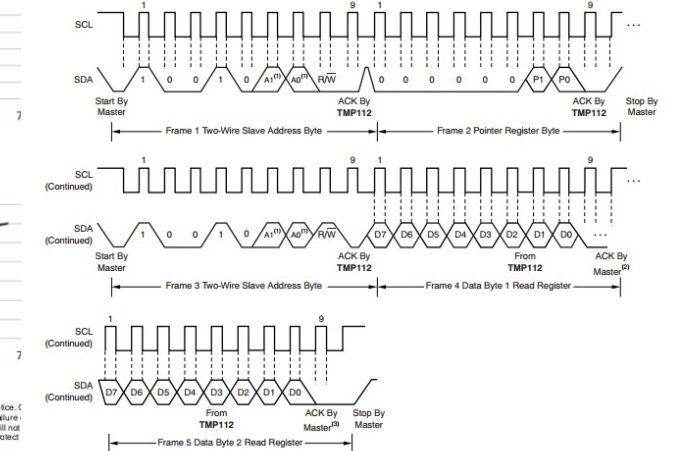
The contents of this document are subject to change without notice. Before ordering or considering the use of CCS devices where failure where extremely high levels of reliability are demanded, CCS will not inherently a certain rate of failure, it is therefore necessary to protect

© Cambridge CMOS Sensors Ltd, Dec

sales@ccmoss.com

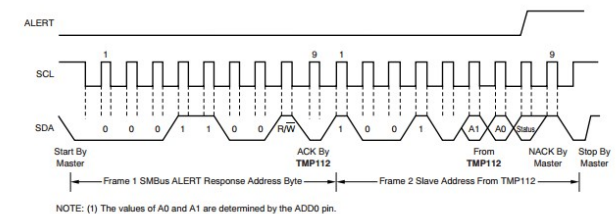
TMP112

SBOS473C-MARCH 2009-REVISED OCTOBER 2014



NOTE: (1) The values of A0 and A1 are determined by the ADD0 pin.
 (2) Master should leave SDA high to terminate a single-byte read operation.
 (3) Master should leave SDA high to terminate a two-byte read operation.

Figure 12. Two-Wire Timing Diagram for Read Word Format



NOTE: (1) The values of A0 and A1 are determined by the ADD0 pin.

Figure 13. Timing Diagram for SMBus ALERT

Hardware is hard: 80% of value & people in s/w but rubber hits road with the other 20%!



Horizontal: IoT technology; Innovate UK funding, new verticals in transport and building health

cut **10%** of UK carbon
for **£100** per household

Damon Hart-Davis

@OpenTRV

simple open tech
big shared benefits